ANALYSIS OF BITTER LAKE

CITY OF WAUBAY

DAY COUNTY, SOUTH DAKOTA

NOVEMBER 2006

South Dakota
Department of Environment and Natural Resources
Division of Environmental Services
Pierre, South Dakota

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Executive Summary

Name of Waterbody: Bitter Lake

Location: Day County, South Dakota

Boundary of Waterbody: Township 121 North, Range 54 West, Sections 3, 4, 8, 9, 10, 15, 16, 17, 20, 21, 22, 23, 27, 28, 29, 33 and 34, Day County.

Recommendation: It is recommended that the assigned beneficial use classification for Bitter Lake be upgraded to (4) Warmwater permanent fish life propagation waters; (7) Immersion recreation waters; and (8) Limited contact recreation waters.

Bitter Lake covers approximately 9,900 acres with a maximum depth of 24 feet. Bitter Lake has become a major fishery and recreational use waterbody.

Introduction

The Department of Environment and Natural Resources received a renewal application from the city of Waubay for their surface water discharge permit. The South Dakota Surface Water Quality Standards ARSD 74:51:01:02.01 require that a use attainability analysis be performed to determine if the waterbody is properly classified.

General Site Description

The wastewater treatment facility (WWTF) for the city of Waubay serves a population of 662 (2000 census). Waubay's WWTF consists of a 2-cell stabilization pond system (5.25 acres each), and two infiltration/percolation (I/P) basins (0.6 acres each). The stabilization ponds can be operated in series or parallel. The city discharges intermittently during the year. The discharge enters an unnamed tributary of Bitter Lake located in the southeast ¼ of Section 3, Township 121 North, Range 54 West, Day County; and travels ½ mile to its confluence with Bitter Lake in the southeast ¼ of Section 3, Township 121 North, Range 54 West, Day County, South Dakota. Wastewater discharge from Waubay will reach Bitter Lake; therefore, Bitter Lake is considered the receiving waterbody for the purpose of developing a surface water discharge permit for the city of Waubay.

Results and Discussion

Due to high precipitation during the 1990s, the water level in Bitter Lake has encroached to within one-half mile of the city's WWTF. Bitter Lake is currently classified as (9) Fish and wildlife propagation, recreation, and stock watering waters.

Despite the current classification, the Department of Game, Fish and Parks currently manages Bitter Lake as a warmwater permanent fishery. With the rise in water level in Bitter Lake, the South Dakota Department of Game, Fish and Parks (GF&P) began stocking game fish in 1997. Walleye and yellow perch were stocked in 1997 and 1998.

Walleye were the only species stocked in 1999, 2000, and 2005. Northern pike have not been stocked but are present in the lake with adult individuals of sufficient reproductive size.

Primary fish species in Bitter Lake include walleye, northern pike, and yellow perch. Other species of fish include common carp, spottail shiner, white bass, and white sucker.

Dennis Unkenholz, Fishery Program Administrator for South Dakota Game Fish and Parks, explained that a major game fishery has developed in Bitter Lake. Mr. Unkenholz said the fishery has developed on the lake as a result of stocking walleye and yellow perch, and natural reproduction including walleye, yellow perch, and northern pike.

The rise in water level at Bitter Lake and the natural reproduction of major game fish has resulted in this lake becoming one of the major fishing and recreational spots in northeastern South Dakota. The lake is being used for swimming, boating, jet skiing, and other recreational uses. It is recommended that Bitter Lake be reclassified as (4) Warmwater permanent fish life propagation waters; (7) Immersion recreation waters, and (8) Limited contact recreation waters.

Reference Documents

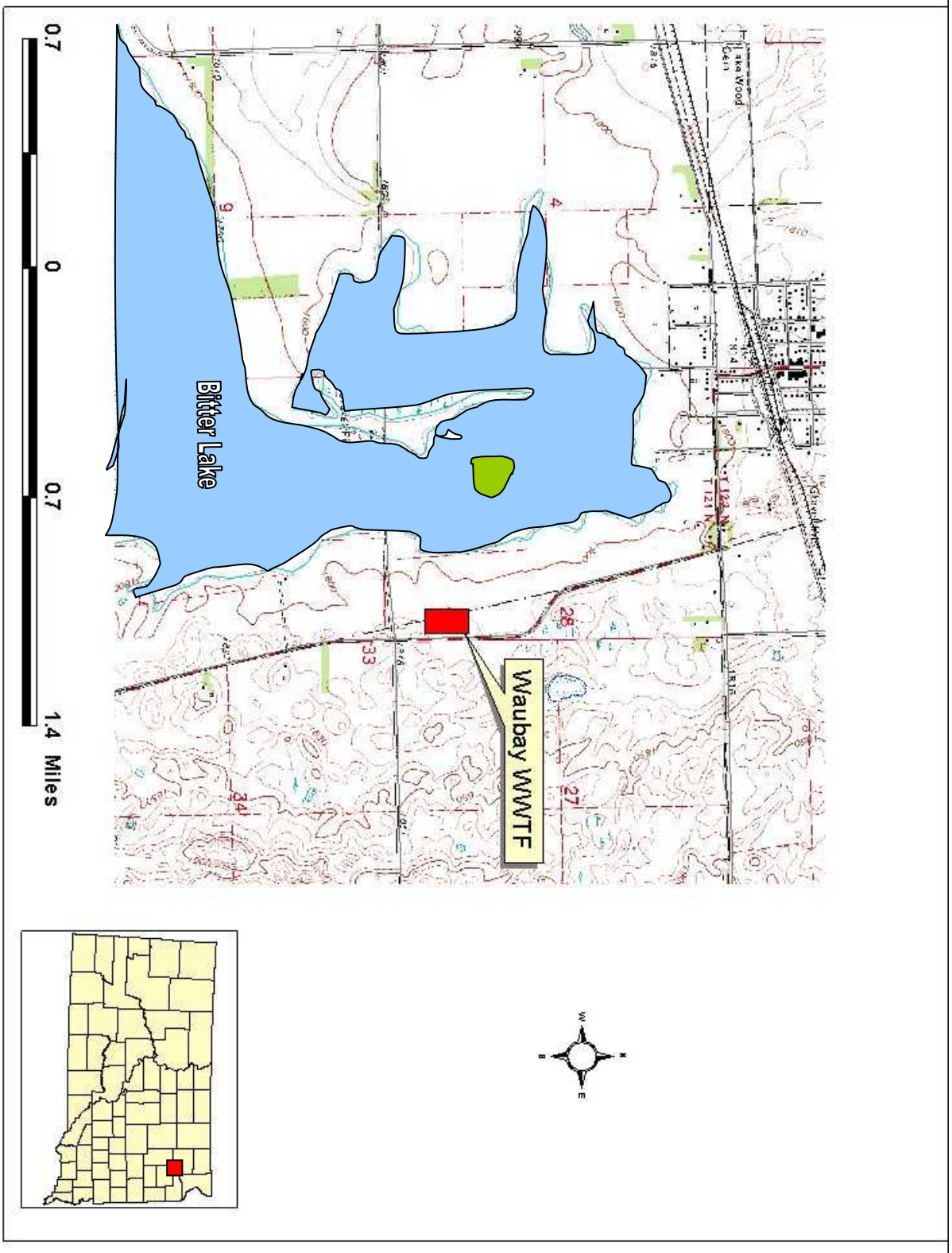
South Dakota Department of Environment and Natural Resources. 1999. Recommended Procedures for Reviewing Beneficial Use Designations, With Special Emphasis on Fishery and Recreational Uses.

South Dakota Department of Environment and Natural Resources. 2006. Wastewater Discharge Permit for the City of Waubay. SD-0020125.

South Dakota Department of Game, Fish and Parks. 2006. South Dakota Statewide Fisheries Survey 2003-2005, Survey of Public Waters.

South Dakota Department of Environment and Natural Resources. Chapters 74:51:01 and 74:51:03, Surface Water Quality Standards.

ATTACHMENT 1



ATTACHMENT 2

South Dakota Department of Game, Fish, and Parks

South Dakota Statewide Fisheries Survey 2003 – 2005
Survey of Public Waters

Bitter Lake

Bitter Lake

Site Description

Location

Water designation number (WDN)	22-0016-00
Legal description	T121N-R54W-Sec. 8-10, 15-17, 20-23, 27-29, 33, 34
County (ies)	Day
Location from nearest town	one half mile south of Waubay

Survey Dates and Netting Information

Dates of current survey	September 3-5, 2003 August 31 – September 8, 2004 August 30 – September 1, 2005; September 20, 2005
Date of most recent survey	September 1-3, 2002
Gill net sets (n)	6 (2003); 8 (2004; 2005)
Frame net sets (n)	0
Spring electrofishing (min)	0
Fall electrofishing (min)	42 (2003); 55 (2004); 60 (2005)

Morphometry (Figure 1)

Watershed area (acres)	71,248.0
Surface area (acres)	9,900.0
Maximum depth (ft)	24.0
Mean depth (ft)	---

Ownership and Public Access

Bitter Lake is a meandered lake managed by the SDGFP. Prior to 1998 much of the shore of Bitter Lake was a 2,353 acre Game Production Area (GPA) managed by the South Dakota Game, Fish and Parks. Currently, much of the Bitter Lake GPA is under water and Bitter Lake is largely surrounded by private land. A public access site is located on the east shore off highway 1 and is maintained by the SDGFP (Figure 1). Public access may also be obtained at numerous submerged roads around the lake. Private (fee) access is available on the northeast shore just outside the city limits of Waubay.

Watershed and Land Use

The Bitter Lake watershed is comprised of a mix of pasture (50%) and cropland (50%).

Water Level Observations

Water levels remain above the historic average.

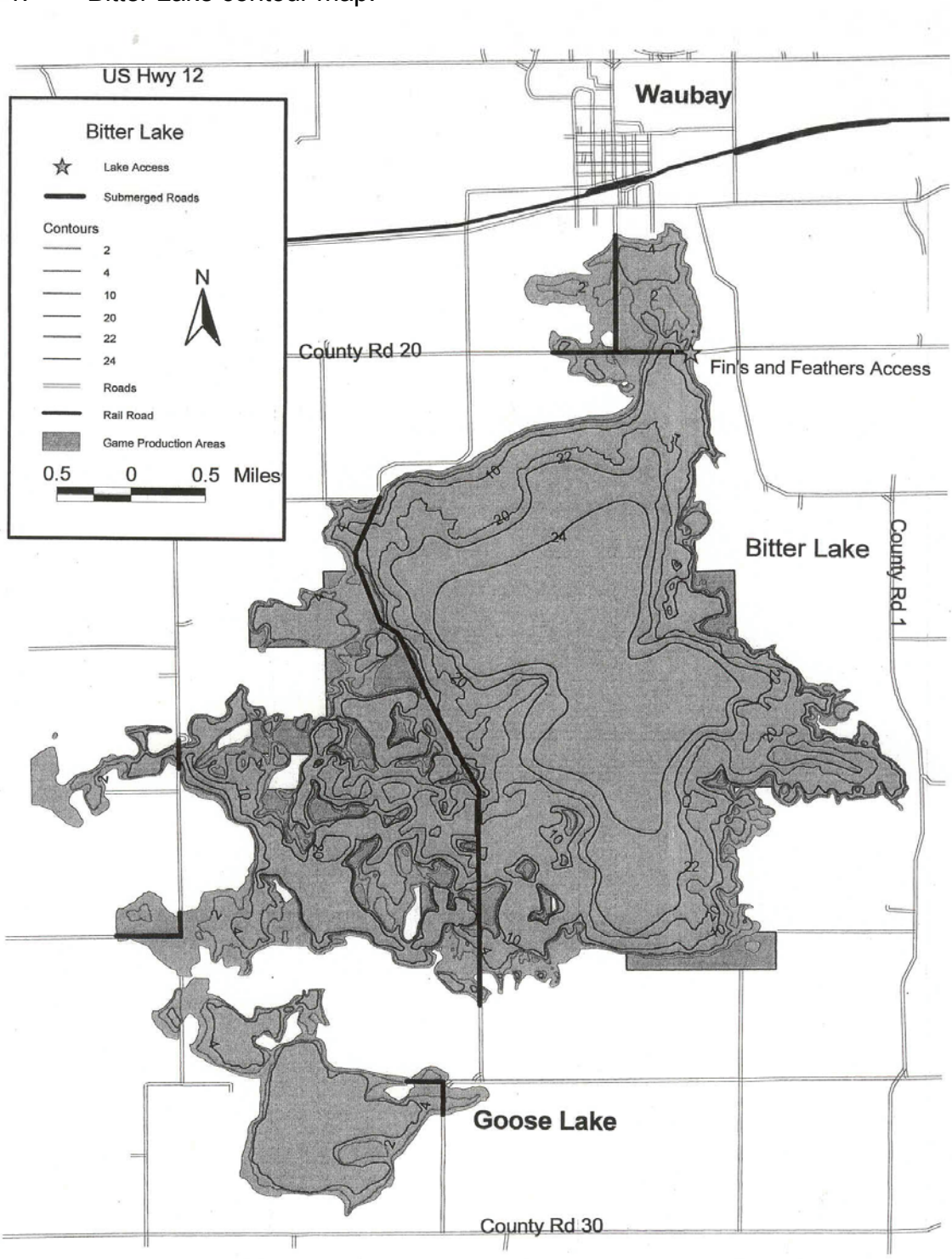
Aquatic Vegetation and Exotics

Localized regions of submerged vegetation (sago pondweed *Potomogeton pectinatus*) can be found in Bitter Lake. The windswept nature of Bitter Lake probably will not be favorable to submerged vegetation growth except in protected backwaters. No un-naturalized exotic vegetation or wildlife was reported during this survey.

Fish Management Information

Primary species	northern pike, walleye, yellow perch
Other species	common carp, spottail shiner, white bass, white sucker
Management classification	warm-water permanent
Fish Consumption Advisories	mercury: walleye (all sizes); northern pike (> 30”). See the South Dakota fishing handbook for more details on meal and portion size recommendations.

Figure 1. Bitter Lake contour map.



Management Objectives

1) Maintain a mean gill net CPUE of stock length walleye ≥ 10, a PSD of 40 – 60, an RSD-P of 5 – 10, and a mean Wr > 80.

2) Maintain a mean gill net CPUE of stock length yellow perch ≥ 15 and a mean Wr > 80.

3) Monitor water levels and winterkill events.

Results and Discussion

Bitter Lake is a large, natural lake situated in the Coteau des Prairie, a plateau formed by glacier action in northeast South Dakota. Prior to the 1990's Bitter Lake was a 3,000 acre alkaline slough with approximately 3 foot maximum depth and unable to support sport fish. A decade of above average precipitation from 1990 through 2000 resulted in a chain of lakes leading into Bitter Lake filling and subsequently overflowing into Bitter Lake. Bitter Lake has tripled in size, now covering almost 10,000 acres. In addition, the depth of Bitter Lake has increased significantly and now areas of 24 feet in depth are common. Currently Bitter Lake is primarily managed as a northern pike, walleye and yellow perch fishery. Overall, as many as seven species of fish contribute to the fishery in Bitter Lake.

Primary Species

Northern Pike: The CPUE of stock length northern pike in Bitter Lake during 2005 was 0.4 for gill nets (Table 1). Northern pike typically are not sampled consistently using standard lake survey methods; however, northern pike in Bitter Lake have generally been considered moderate density with a 1999 – 2000 mean CPUE of stock length fish of 1.4 for gill nets (Table 1; Table 2). Northern pike were collected from Bitter Lake that ranged in length from 740 to 760 mm (Figure 2). The PSD and RSD-P were each 100 for northern pike captured in gill nets indicating that the population in Bitter Lake is comprised largely of quality (≥ 530 mm) length pike (Table 1; Table 3; Figure 2).

No growth information was available. The condition of northern pike was below the objective range (≥ 80) with a mean Wr of 74 for pike captured in gill nets. The small sample size (n = 3) and large size of northern pike weighed during the 2005 survey could have made obtaining accurate measurements difficult. Based on the 2003 and 2004 surveys the Wr of northern pike had been within an acceptable range but had fluctuated among years (Table 1; Table 3). Overall, it is likely that Bitter Lake contains sufficient food availability for acceptable northern pike condition. The northern pike population benefits from the many shallow and "weedy" bays in Bitter Lake. Lowering water levels could

impact reproductive success by exposing critical spawning habitat; however, the northern pike population is currently believed to be in a healthy state.

Walleye: The mean gill net CPUE of stock length walleye during 2005 was 20.0 (Table 1) and above the objective range (≥ 10 stock length fish/net night) for walleye in Bitter Lake. Dating back to 1999 walleye abundance in Bitter Lake based on gill net CPUE has ranged from 13.7 to 25.8 stock length walleye/net night with an average of 17.5 (Table 2; Table 3). The gill net CPUE of stock length walleye during 2005 indicated moderate-high density and the second highest abundance since 1999.

Walleye captured in gill nets during 2005 ranged in length from 130 to 520 mm (Figure 3). The PSD of walleye captured in gill nets during 2005 was 96 and the RSD-P was 1 (Table 1; Table 3; Figure 3). The 2005 PSD of 96 was above the objective PSD range (40 – 60). Conversely, the RSD-P of 1 for walleye in 2005 was below the objective range of 5 – 10 indicating a lower than desired proportion of preferred length (≥ 508 mm) walleye in the population. Similar to the 2003 and 2004 survey, a wide length range of walleye were captured during the 2005 survey. Of the walleye captured a high percentage were within the quality (380 mm) length group sought by most anglers. Approximately 48 percent of the walleye captured in gill nets were above the 406 mm (16 inch) minimum length restriction enforced on Bitter Lake (Figure 3).

During the 2005 survey a total of eight year classes of walleye were represented in the catch (Table 6; Table 8). All of the stockings, which occurred in 1997 – 2000, were represented in the walleye catch (Table 7; Table 8). Natural reproduction by walleye in Bitter Lake was apparently successful during at least four of the past 10 years, which included 2001 – 2004. Natural reproduction was likely successful in other years but the extent of its success was unknown due to the confounding of the catch with stocked walleye. Natural reproduction by walleye in Bitter Lake has been variable from year-to-year with fall night electrofishing CPUE of walleye during non-stocked years (e.g., 2002 – 2004) ranging from 0 to 104 fish/hour (Table 2). The 2002 naturally produced year class was likely the strongest since 2000. Since 2002, year classes have been relatively weak; therefore, 9.1 million walleye fry were stocked into Bitter Lake during the spring of 2005.

Based on the history of year classes in Bitter Lake it is likely that periodic stockings to maintain the walleye population are needed. Walleye stocking should be implemented in cases where fall night electrofishing CPUE of walleye falls below 75. A fall electrofishing CPUE of ≥ 75 would indicate a sufficiently sized year class at the time of sampling and in such cases no walleye should be stocked the following year to reduce the likelihood of slowed growth due to overpopulation. This strategy assumes that walleye observed in fall electrofishing samples would survive over-winter and develop a sustaining year

class. During 2005, fall night electrofishing yielded a young-of-the-year CPUE of 90 fish/hour; therefore, no walleye should be stocked in 2006.

Growth of walleye was similar in 2003 and 2004 (Table 4; Table 5). Generally, growth of walleye in Bitter Lake has been slightly slower than the regional and statewide average with walleye achieving quality length (380 mm) between age-3 and age-4. Walleye apparently depend largely on aquatic invertebrates, namely amphipods, for sustenance in Bitter Lake. During the 2005 survey growth was moderate for walleye in Bitter Lake (Table 6), but slightly faster than previous years. Condition of stock length walleye captured in gill nets in 2005 was 89 and above the objective range of ≥ 80. There was no apparent pattern in Wr among various length groups indicating appropriate food availability to all fish sizes. Overall, walleye growth during 2005 was indicative of moderate growth, with good condition and sufficient availability of food.

Yellow Perch: The mean gill net CPUE of stock length (200 mm) yellow perch in 2005 was 2.6 and below the objective range (≥ 15 fish/net night) for perch in Bitter Lake (Tables 1 – 3). Since 1999 the gill net CPUE of stock length yellow perch has fluctuated with a low of 2.2 (2003) and a high of 7.2 (2002) (Table 2; Table 3). Overall, the yellow perch population in Bitter Lake is classified as low density.

During 2005, yellow perch ranged in total length from 90 to 310 mm (Figure 4), had a PSD of 76, and an RSD-P of 43 (Tables 1 – 3; Figure 4). Yellow perch commonly obtain 90 mm at age-1 and 150 mm at age-2. Inspection of the length frequency histogram indicates a number of consecutive year classes (Figure 4). Although yellow perch likely maintain consistent recruitment in Bitter Lake the year classes formed are generally weak and the abundance remains at a low density. The condition of yellow perch in Bitter Lake was within the objective (≥ 80) with a mean Wr of 113. The low abundance of yellow perch in Bitter Lake promotes larger yellow perch and anglers capture the occasional trophy perch.

Other Species

Black crappie: Frame nets are the most effective method in sampling black crappie; however, frame nets are not utilized in Bitter Lake. Black crappie are occasionally captured in gill nets during standardized lake surveys and the black crappie population in Bitter Lake is believed to be very low density and not likely to become a major target species for Bitter Lake anglers. If black crappie were to become an important species in the sport fishery at Bitter Lake then the addition of frame nets to the standardized survey methods on the lake would be recommended.

Other: Common carp, white bass and white sucker were other fish species captured during the 2005 survey; however, the abundance of these fish species

was considered low density (Table 1, Table 2). The contribution of species other than northern pike, walleye and yellow perch to the fishery at the time of this survey was likely minimal.

Summary

Bitter Lake is managed as a northern pike, walleye and yellow perch fishery. Due to the low abundance of bullhead, sunfish, and crappies frame nets are not utilized during standard lake surveys on Bitter Lake. In fact, the fish species composition of Bitter Lake is relatively simple given the large expansive makeup of the lake. At present, a total of seven fish species are known to exist in Bitter Lake, which is less species by number than most lakes in northeastern South Dakota.

Northern pike are likely present in relatively large numbers in Bitter Lake; however, the pike in the lake are not sampled consistently during the standardized sampling. Anglers have reported catching northern pike frequently during both open water and ice fishing on Bitter Lake. It is likely that northern pike are in relatively high density in Bitter Lake when compared to other northeastern lakes even though netting data may indicate only moderate-low density. In addition, the northern pike population in Bitter Lake contains some fish in the preferred (≥ 710 mm) length range that are sought by some anglers. Overall, the northern pike population in Bitter Lake appears healthy and likely provides an excellent angling opportunity during the spring, fall, and winter.

During 2005, the abundance of stock length (130 mm) yellow perch in Bitter Lake based on mean gill net CPUE indicated that the yellow perch population was of low density and well below the objective range of ≥15 stock length fish/net. Although yellow perch likely maintain consistent recruitment in Bitter Lake the year classes formed are generally weak resulting in the low density of perch in the lake. The low abundance of yellow perch in Bitter Lake promotes larger perch and the occasional trophy fish is captured by anglers.

The abundance of stock length (250 mm) walleye in Bitter Lake based on mean gill net CPUE was indicative of a moderate-high density population and was above the objective range of ≥ 10 stock length fish/net. In fact, the 2005 estimated abundance was above the 1999 – 2005 average and the second highest relative abundance observed during that period. The PSD of 96 for walleye in Bitter Lake during 2005 was above the objective of 40 – 60. Walleye in Bitter Lake grow relatively slow compared to other waters in northeastern South Dakota achieving only 380 mm (quality length; 15-inches) in about four years; however, the condition of walleye in the lake meets the objective range (Wr ≥ 80). Roughly 48 percent of the walleye collected from Bitter Lake during the 2005 survey were above the 406 mm (16-inch) minimum length restriction and available for angler harvest. Abundance of young-of-the-year walleye based on fall night electrofishing indicated that the 2005 fry stocking, natural

reproduction, or some combination of both was successful during 2005 and that stocking in 2006 was not needed. Overall, Bitter Lake has historically provided anglers with good walleye fishing with a wide range of fish lengths and the opportunity to capture quality (≥ 380 mm) and preferred length (≥ 508 mm) fish.

Management Recommendations

1) Conduct fish population assessment surveys on an annual basis (next survey scheduled in summer 2006) to monitor fish abundance, fish population size structures, fish growth, and stocking success.

2) Conduct fall night electrofishing on an annual basis to monitor walleye young-of-the-year abundance.

3) Stock walleye on a biennial basis at 1,000 fry/acre to maintain consistent year classes only if the fall night electrofishing CPUE of young-of-the-year walleye falls below 75 fish/hour. Stock northern pike and yellow perch in cases of complete winterkill events to establish a fish population. Monitor water levels and winterkill events to assess stocking strategies.

Table 1. Mean catch rate (CPUE; Catch/net night) of stock length fish, mean relative weight (Wr) of stock length fish, proportional stock density (PSD) and relative stock density of preferred length fish (RSD-P) of various fish species captured in experimental gill net sets or frame net sets in Bitter Lake, 2003 - 2005. Confidence intervals include 80 percent (± CI-80) or 90 percent (± CI-90).

Survey Year	Abundance		Stock Density Indices				Condition	
Species	CPUE	CI-80	PSD	CI-90	RSD-P	CI-90	Wr	CI-90
2003								
Gill nets								
COC	0.2	0.3	0	0	0	0	109	---
NOP	1.5	1.1	100	0	33	31	80	3
WAE	25.8	10.5	51	7	2	2	90	< 1
YEP	2.2	0.9	77	22	23	22	114	5
Electrofish[2,3]								
WAE	1.4	2.3	---	---	---	----	---	---
2004								
Gill nets								
NOP	1.3	0.7	100	0	10	18	84	3
WAE	17.9	7.5	76	6	1	1	94	< 1
YEP	2.9	1.1	96	4	61	18	112	3
Electrofish[2,3]								
WAE	0.0	0.0	---	---	---	---	---	---
2005								
Gill nets								
COC	0.1	0.2	0	0	0	0	---	---
NOP	0.4	0.4	100	0	100	0	74	3
SPS [1]	0.6	0.6	---	---	---	---	---	---
WAE	20.0	2.4	96	3	1	2	89	< 1
WHB	0.1	0.2	100	---	0	---	108	---
WHS	0.3	0.2	50	50	50	50	99	---
YEP	2.6	1.9	76	17	43	19	113	---
Electrofish[2,3]								
WAE	90.1	37.1	---	---	---	---	---	---

[1] all fish sizes.
[2] fall night electrofishing.
[3] age-0 fish only.

Table 2. Historic mean catch rate (CPUE; Catch/net night) of stock length fish for various fish species captured in experimental gill net sets, frame net sets, or electrofishing in Bitter Lake, 1999 - 2005.

	CPUE							
Species	1999	2000	2001	2002	2003	2004	2005	Mean
Gill nets								
BLC	0.0	---	0.0	0.0	0.0	0.0	0.0	0.0
COC	0.0	---	0.2	0.0	0.2	0.0	0.1	0.1
NOP	2.5	---	1.5	1.2	1.5	1.3	0.4	1.4
SPS [1]	0.0	---	0.0	0.0	0.0	0.0	0.6	0.1
WAE	16.7	---	17.0	13.7	25.8	17.9	20.0	17.5
WHB	0.0	---	0.0	0.0	0.0	0.0	0.1	0.0
WHS	0.0	---	0.0	0.0	0.0	0.0	0.3	0.1
YEP	4.8	---	6.8	7.2	2.2	2.9	2.6	4.4
Electrofishing								
WAE [2,3]	---	---	---	104.4	1.4	0.0	90.1	49.0

[1] all fish sizes.
[2] fall night electrofishing.
[3] age-0 fish only.

Table 3. Mean catch rate (CPUE; catch/net night), proportional stock density (PSD), relative stock density of preferred length fish (RSD-P), and relative weight (Wr) for primary management species captured in experimental gill net sets, frame net sets, or electrofishing in Bitter Lake, 1999 - 2005.

Species	1999	2000	2001	2002	2003	2004	2005	Average	Objective
Gill nets									
NOP									
CPUE	3	---	2	2	2	1	< 1	2	≥ 2
PSD	87	---	100	92	100	100	100	81	30 – 60
RSD-P	13	---	22	8	33	10	100	30	5 – 10
Wr	80	---	83	81	80	84	74	80	≥ 80
WAE									
CPUE	17	---	17	14	26	18	20	18	≥ 10
PSD	42	---	36	49	51	76	96	51	40 – 60
RSD-P	0	---	0	2	2	1	1	1	5 – 10
Wr	86	---	90	88	90	94	89	90	≥ 80
YEP									
CPUE	5	---	7	12	2	3	3	5	≥ 15
PSD	72	---	22	30	77	96	76	57	---
RSD-P	52	---	12	20	23	61	43	32	---
Wr	112	---	116	113	114	112	113	113	≥ 80

[1] Historic data from all surveys conducted since 1999.

Table 4. Mean back-calculated length (mm) at age and standard error (SE) for walleye captured in experimental gill net sets in Bitter Lake, 2003.

			Age					
Year	Age	N	1	2	3	4	5	6
2003	0	2	---	---	---	---	---	---
2002	1	26	160	---	---	---	---	---
2001	2	22	151	264	---	---	---	---
2000	3	55	126	244	323	---	---	---
1999	4	38	144	256	333	379	---	---
1998	5	14	146	262	344	400	431	---
1997	6	1	211	365	423	471	506	540
Mean	---	158	156	278	356	417	469	540
SE	---	---	12	22	23	28	38	0
Mean Comparison [1]								
Small lakes/impoundments			176	271	384	431	483	---
Large lakes/impoundments			169	280	358	425	494	---
Region IV			161	281	367	433	497	---
Statewide			168	279	360	425	490	---

[1] Willis et al. 2001.

Table 5. Mean back-calculated length (mm) at age and standard error (SE) for walleye captured in experimental gill net sets in Bitter Lake, 2004.

			Age					
Year	Age	N	1	2	3	4	5	6
2002	2	38	165	301	---	---	---	---
2001	3	45	154	270	357	---	---	---
2000	4	21	142	268	350	407	---	---
1999	5	29	133	243	332	377	413	---
1998	6	8	138	242	328	386	424	450
Mean	---	141	146	265	342	390	419	450
SE	---	---	6	11	7	9	5	0
Mean Comparison [1]								
Small lakes/impoundments			176	271	384	431	483	---
Large lakes/impoundments			169	280	358	425	494	---
Region IV			161	281	367	433	497	---
Statewide			168	279	360	425	490	---

[1] Willis et al. 2001.

Table 6. Weighted mean length at capture (mm) for walleye captured in experimental gill net sets in Bitter Lake, 1999 – 2004. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends.

		Age							
Year	N	1	2	3	4	5	6	7	8
2005	155	295	383	410	429	440	455	438	478
2004	141	---	371	401	436	432	466	---	---
2003	156	279	345	382	411	455	552	---	---
2002	85	258	310	361	405	477	---	---	---
2001	97	263	342	372	413	403	---	---	---
1999	128	252	382	---	---	---	---	---	---

Table 7. Stocking history (20-year) including size and number for fishes stocked into Bitter Lake, 1986 - 2005.

Year	Species	Size	Number
1997	WAE	fingerling	95,650
	YEP	adult	8,000
1998	WAE	fry	9,228,000
	YEP	juvenile	1,875
	YEP	adult	5,340
1999	WAE	fry	5,322,000
	WAE	fingerling	404,100
2000	WAE	fry	8,015,200
2005	WAE	fry	9,050,000

Table 8. Numbers of walleye sampled (n) by year class and associated stocking history (Number stocked x 1,000) for walleye captured in Bitter Lake, 1999 - 2004.

	Year Class								
Survey Year	2004	2003	2002	2001	2000	1999	1998	1997	1996
2005	2	7	52	47	15	14	16	2	
2004	---		38	45	21	29	8		
2003	---	---	26	22	55	38	14	1	
2002	---	---	---	9	16	16	40	4	
2001	---	---	---	---	8	24	43	19	
1999	---	---	---	---	---	---	56	72	
Number stocked									
fry					8,015	5,322	9,228		
small fingerling						404		96	
large fingerling									

Figure 2. Length frequency, catch rate of stock length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred length fish (RSD-P) for northern pike captured in gill net sets in Bitter Lake, 2003 – 2005.

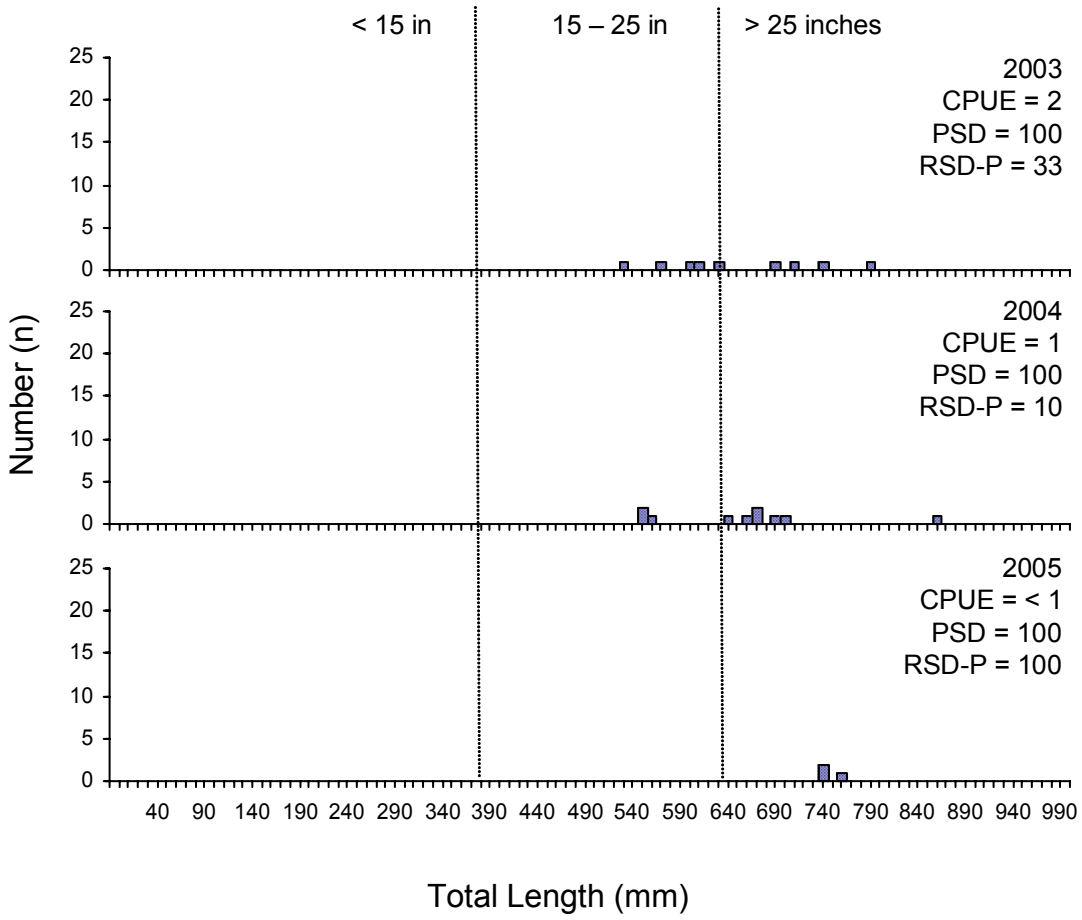


Figure 3. Length frequency, catch rate of stock length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred length fish (RSD-P) for walleye captured in gill net sets in Bitter Lake, 2003 – 2005.

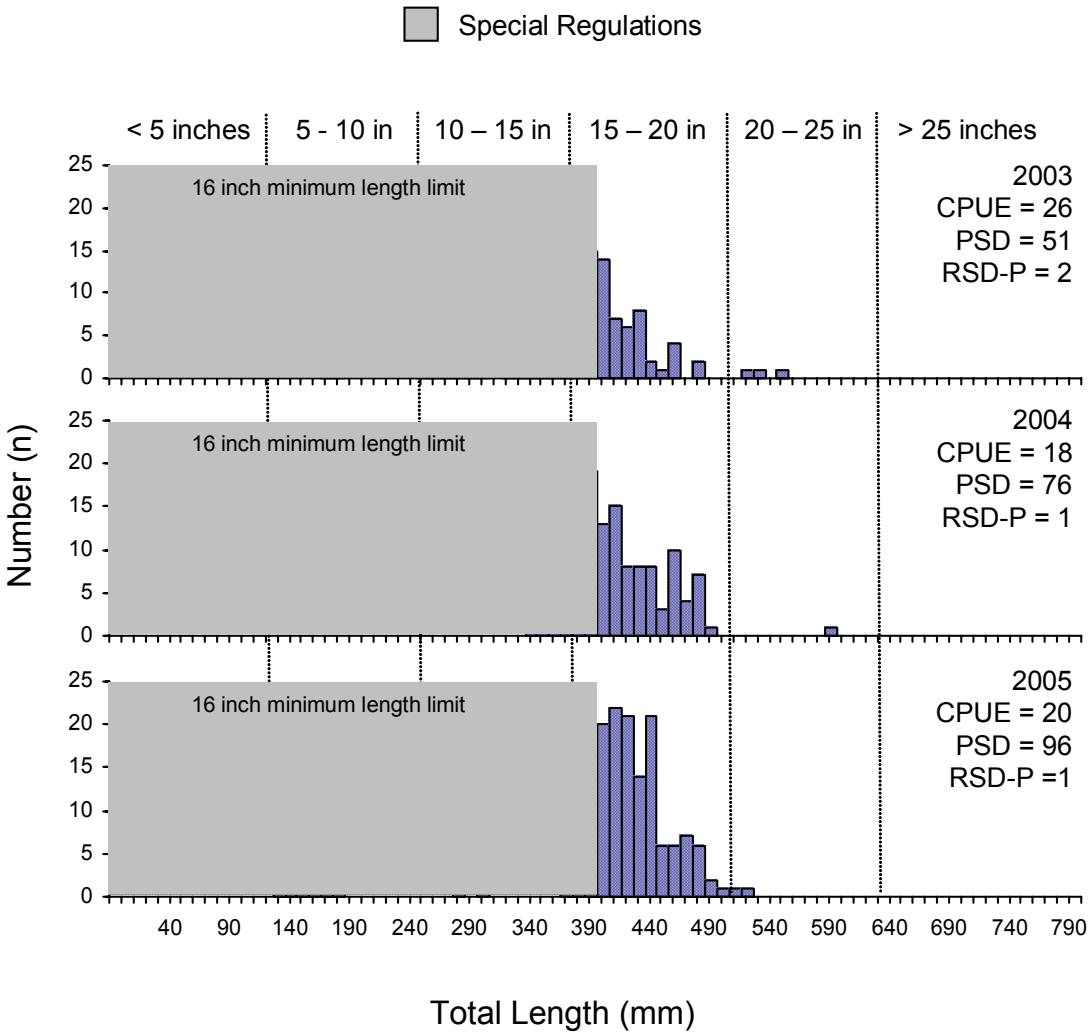


Figure 4. Length frequency, catch rate of stock length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred length fish (RSD-P) for yellow perch captured in gill net sets in Bitter Lake, 2003 – 2005.